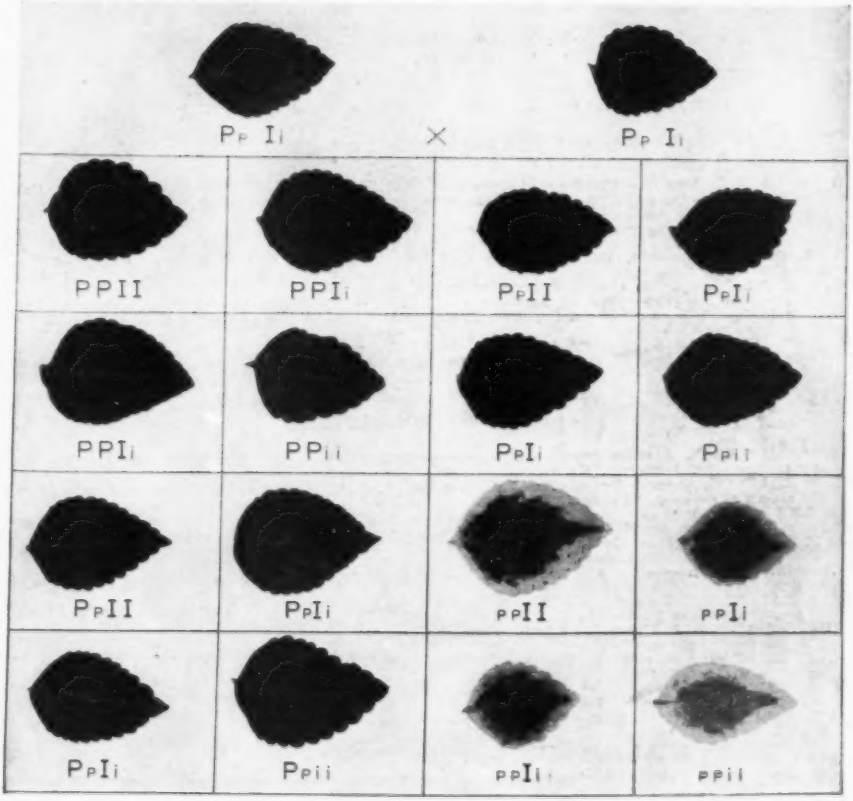
PEARL

The Journal of HEREDITY



A "CHECKERBOARD" OF COLEUS LEAF PATTERNS

(SEE PAGE 55)

"National" Eugenics

Non-Homing Homer Pigeons

A Record of Egg Production

Possibilities in Human Selection

Buff Spotting in Dogs and Mice

VOLUME 29 FEBRUARY, 1938 NUMBER 2

The American Genetic Association

An incorporated organization devoted to promoting a knowledge of the laws of heredity and their application to the improvement of plants, animals, and human racial stocks

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SHE LAID OVER TWO HUNDRED POUNDS OF EGGS

Frontispiece

Breaking all records for sustained egg production, Leghorn R1149, of the Cornell Station flock, laid a total of 1,515 eggs over a period of eight years. Her total production in any one year was not record-breaking, but for the first four years she actually produced over two hundred eggs a year, and after that her production remained so high that she *averaged* over two hunderd eggs a year for the first seven years. The Cornell Flock was established in 1910, and since that time approximately eighty hens have attained a total production of over 1,000 eggs. If laying hens could be bred to show the persistency in high production which R1149 has achieved, the saving in the poultry industry would be enormous.

AN UNPRECEDENTED RECORD OF SUSTAINED HIGH EGG PRODUCTION

In the Domestic Fowl

G. O. HALL

Department of Poultry Husbandry, Cornell University, Ithaca, N. Y.

REPRODUCTION in the domestic fowl is commonly referred to as "production." It is true that only a very small percentage of the eggs laid by chickens are used for the purpose of reproducing new stock, yet each egg laid by a domestic hen may have all the potentialities of a new individual. Most eggs are used for human consumption, hence the term "production."

Beebe[1] states that the usual number of eggs laid by the Red Jungle Fowl (*Gallus gallus*) is from 5 to 8. As high as 11 eggs, credited to one bird, have been found deposited in one nest. Even when two such clutches were laid in a breeding season, the annual production would be very low. According to estimates of the Federal Bureau of the Census the four hundred million adult birds in the United States have an annual average production of 80 eggs per bird. Such a figure, if correct, is slightly more than one third of the average production obtained on good poultry farms and in some laying tests.

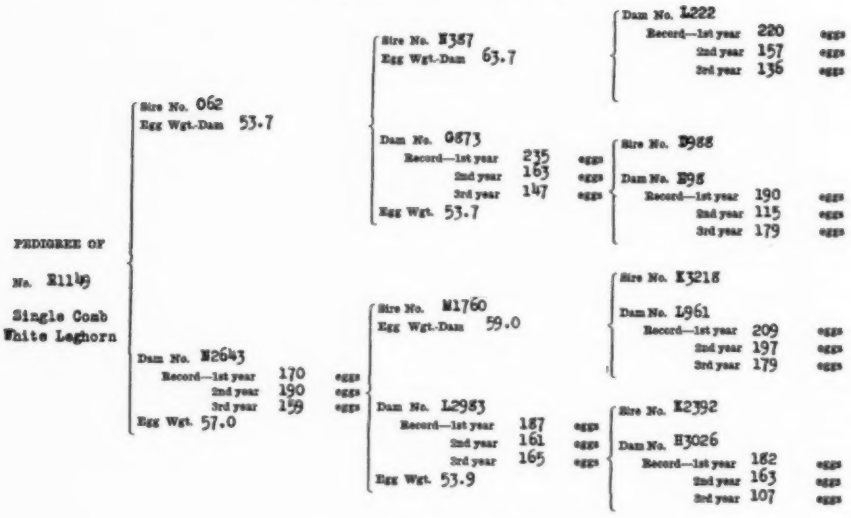
Accurate lifetime records of the egg production of individual birds are very few in number. It is a well-known fact that most birds produce the greatest number of eggs during the first year of production, and that there is a rather marked relationship between the number of eggs laid during the first year and that of succeeding years, with a gradual decrease after the first year. Under commercial conditions it is unusual for any birds to be kept longer than three or four years. By far the largest percentage of birds are disposed of during and at the end of the first laying year. Brody, Henderson and Kempster[2] found that the egg production of any year was 88 per cent of that for the preceding year in the flock of 240 birds studied, with records over a period of eight years. Hall and Marble[3] in an analysis of the records of 1,867 birds found a decrease of about 13 per cent from year to year. Jull,[4] in compiling a large number of data comparing first and second year records, found that in most instances second year production did not reach 88 per cent of that of the first year.

The Record of R1149

A very unusual case of sustained high egg production is recorded among the records of the flock of Single Comb White Leghorns of the Cornell University Agricultural Experiment Station. This bird, R1149, was hatched April 6, 1927, and laid her first egg October 29, 1927, at 206 days of age. During the first year she laid 241 eggs. Her production by years and her average annual egg weights are as follows:

Year	Annual Production	Annual Egg Weight (grams)
1927-28	241	52.7
1928-29	221	56.6
1929-30	214	54.6
1930-31	210	55.7
1931-32	188	56.1
1932-33	152	57.4
1933-34	175	55.4
1934-35	114	53.6

She produced a total of 1,515 eggs during eight years of production and it is a very interesting fact that she averaged 200 eggs annually during the first seven years of this period. As far as the writer has been able to determine from the literature, or from unpublished reports, this is the greatest number of eggs produced by an individual



PEDIGREE OF R1149

Figure 1

Her female ancestors for three generations show a rather high rate of egg production. Possibly one can note in several of these ancestors an unusual tendency to maintain a high average for the three year period.

bird, either during a period of eight years or for any number of years. There are many records in the files of the Cornell Experiment Station flock, of birds which have lived and continued to produce over a much longer period of time, but none of these birds has equalled the production of R 1149. It may be of interest to note that approximately 80 hens in the Cornell flock, since its beginning in 1910, have produced from 1,000 to 1,515 eggs each during their lifetimes.

Hen R 1149 had an average weight of 1,778 grams during her first laying year. She reached her maximum weight of 2,000 grams during 1933-34 in her seventh year of production. This is slightly below standard weight for the variety. Her average annual egg weight has varied from year to year. The decline in egg weight during the last year, with very much reduced production, is interesting.

Fertility

The record of reproduction of R 1149 is not outstanding. She was not mated during her first year. During the second, third and fourth years approximately 80 per cent of her fertile eggs hatched. The percentage dropped to 57.1 per cent in the fifth year, and to 23.8 per cent during the sixth year. Her eggs were all infertile during the hatching season of the seventh year. Only 13.9 per cent of the twenty-five eggs set in the eighth year produced chicks. This decrease in hatching power is common to very old birds.

Only eight daughters from hen R 1149 were trapnested and first year records obtained. Three of these died before the end of the first year. The average production of the remaining five daughters was 239 eggs each. This is an example of what frequently occurs in breeding for such characters as egg production and longevity. This bird, because of her unknown ability as a producer and her capacity for long life, was not given any special consideration and no particular effort was made to save all of her sons and daughters for testing, until after she was four years of age. Her reproductive efficiency de-

clined so rapidly following this period that only a very limited number of progeny were available for testing. The breeder is faced with the problem that there is no way of identifying such individuals until after they have produced over a period of several years and then it may be too late to secure satisfactory progeny from them.

Ancestry

It may be of interest to examine the pedigree of this remarkable bird. A three-generation pedigree showing the production of each female ancestor is shown in Figure 1. It should be noted that each of the female ancestors for the period of three years maintained a relatively high production.

The Frontispiece is a photograph of hen R1149, taken during the late summer of 1935, while she was in dormant condition. The new coat of plumage is almost complete. She died January 15, 1936, at the age of eight years nine months and nine days. A post mortem examination showed that she was afflicted with nephritis bordering on visceral gout. If such birds could be bred in large numbers the economic saving to the poultry industry, due to present flock replacement, would be tremendous.

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NEMATODE RESISTANCE IN POULTRY

Kansas Studies Show Varietal Differences

EVIDENCE was presented for the first time on different degrees of resistance among breeds and varieties of one species to the same helminth. The data supporting the conclusions were derived from experiments on 1,351 chickens of four breeds and two varieties of a fifth breed given the same number of eggs from the nematode *Ascardia lineata* (Schneider). The criteria for judging the resistance were the average number of length of the *Ascaridia lineata* from each group of chickens under comparison. Most resistant to the parasites were the heavy breeds and varieties; Rhode Island Reds, White Plymouth Rocks, and Barred Plymouth Rocks; the more susceptible were the White Leghorns, Buff Orpingtons, and White Minorcas. Factors in the differences in resistance appear to include greater utilization of nervous energy by the most susceptible breed, possible differences in strains within a breed, and the normality or tolerance of the host breeds. Very definite development of increased resistance to the worms developed in all the breeds and varieties of the chickens as they grew older.

The results of two tests on the resistance of 187 chickens to the intestinal nematode, *Ascaridia lineata* (Schneider), in 1932-'33 showed that White Minorca chickens were significantly more resistant to the growth of the *A. lineata* than were White Leghorn chickens. For example, the worms in the Minorcas averaged 19.03 mm. in length and those in Leghorns 23.83 mm., a difference of 4.80 mm. which was 9.72 times the probable error. On the other hand the results of two tests on 178 chickens during the following year showed that the White Minorcas from the same flock were significantly less resistant to the *A. lineata* than were the White Leghorns also from the same flock as before. Worms averaging 23.74 mm. occurred in the Minorcas and those averaging 20 mm. in the Leghorns, a difference of 3.74, which was 4.37 times the probable error.

In July, 1933, a group of chickens rather resistant to *Ascaridia lineata* was obtained. Several females and a male were grown to maturity and the resistance of their offspring compared with that of chicks of the same ages from the College Poultry Farm flock and from a local commercial flock. In each of these tests the offspring of the resistant group were more resistant to the viability and the growth of the *A. lineata* than were the offspring of either the College or of the local commercial flock.

Comparisons were then begun between the resistant group and a susceptible group secured from the local commercial flock. For the last two years, tests have been made on the F_1 and F_2 generations of the resistant and of the susceptible groups. In the F_1 generation, tests on 110 chickens from the resistant group gave an average number of 2.6 worms per bird and an average length of 16.9 mm. Those from the susceptible group averaged 3.7 worms per bird and 20.5 mm. in length, showing that in both numbers and length of worms the F_1 generation chickens from the resistant group were markedly more resistant than were the F_1 generation fowls from the susceptible group.

The result of the experiments with the F_2 generations follow: 133 chickens from the resistant group averaged 7.6 worms per bird with an average length of 25.27 mm. Ninety-nine chickens from the susceptible group averaged 12.5 worms per bird with an average worm length of 24.38 mm. From these results it is seen that the F_2 generation of the resistant group had markedly fewer worms than did those from the susceptible group, while the growth of the worms in the two groups was about the same.—*Biennial Rept. of Kansas Experiment Station*, 1937.

OUR GROWING CITIES

In the general economic situation—and it seems to be largely the economic situation which governs the urban-rural distribution of the population—there is apparently nothing to indicate that the trend of population toward the urban areas has been, or soon might be, permanently checked. New commodities which may be put on the market are likely to be the products of city factories; increased per capita quantities of current commodities which might be in demand, as improving business conditions permit improvement in the standards of living, are likely to be for the most part factory products; and any really significant activities which may be devised to re-employ our present unemployed are likely to be urban activities. On the other hand, with continued improvement in methods of farming, fewer and fewer farmers will be required to supply our slowly increasing population with foodstuffs and textile materials.

Looking forward into the future, then, one might expect a rural population made up of the essential farm population, plus a supplementary population living in the open country and in small villages, perhaps nearly equal to the farm population. These two groups together might eventually constitute no more than 25 or 30 per cent of the total population, which would leave room for an urban population amounting to 70 or 75 per cent, or about one-quarter more than at present. Even at the rate of gain prevailing between 1900 and 1930, however, it would require three decades for the urban population to reach a point where it would constitute this fraction of the total, and its rate of gain may be much less rapid. As a matter of coincidence, the usual date now set for the cessation of growth in the total population is 30 or 40 years into the future—1970 or 1980; so we may perhaps find both a stable population and a stable urban-rural distribution at about the same time.—L. E. Truesdell, Chief Statistician for population, U. S. Census Bureau, in *The Municipal Year Book*, 1937.

MANY KINDS OF NEGROES

To the Editor:

Looking through an old number, Vol. XIII, No. 7, July, 1922, I find an article comparing the intelligence of the negro with that of the white race. In this and other more recent articles I find a fault, or omission, which to me seems remarkably pertinent, the failure to recognize that there are different races of negroes, of vast difference in mentality.

So far as I can see from the article, a negro is just a negro, and all negroes expected to be of the same class, only with some of exceptional brilliance, probably due to intermixture of white blood. While it may be that the slave trade secured its supply mostly from a definitely defined part of Africa, there are many races of negroes in Africa, and there are unquestionably several races represented in this country, differing in physical as well as mental characteristics.

In Africa the Hottentot, it is my understanding, has hardly any mentality at all, whereas in the southern colonies a white man can not get a job at labor if a Kaffir can be secured, the Kaffirs being so active, energetic, and so high in intelligence. A school friend of mine, now vice-president of Tuskegee Institute, possibly carrying some white blood, though much nearer black than white, showed no inferiority in intellect, business ability, moral staunchness, energy, activity, persistence, or initiative.

Yours very truly,

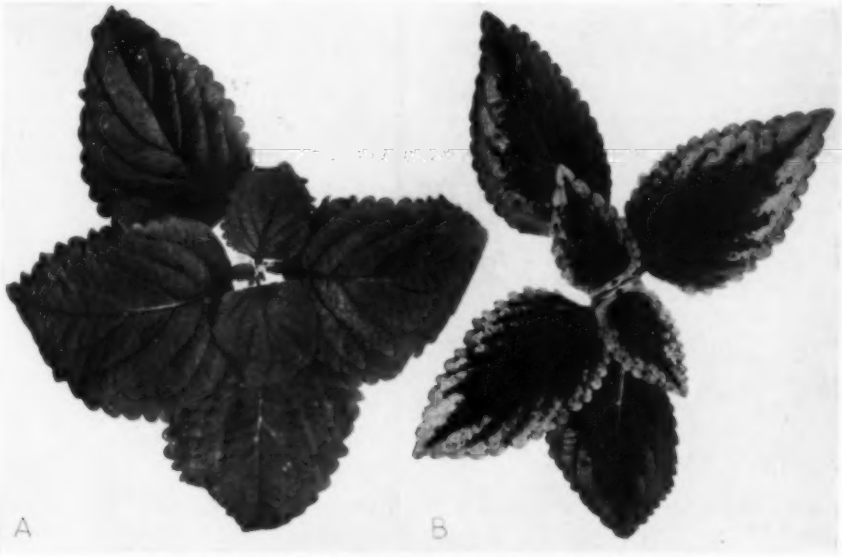
Benjamin C. Auten

Carterville, Mo.

GENETIC STUDIES OF COLEUS I

Leaf Color I

CHARLES L. BOYE and D. C. RIFE
*Genetics Laboratory, The Ohio State University**



SOLID PURPLE AND BROWN CENTERED LEAVES
Figure 2

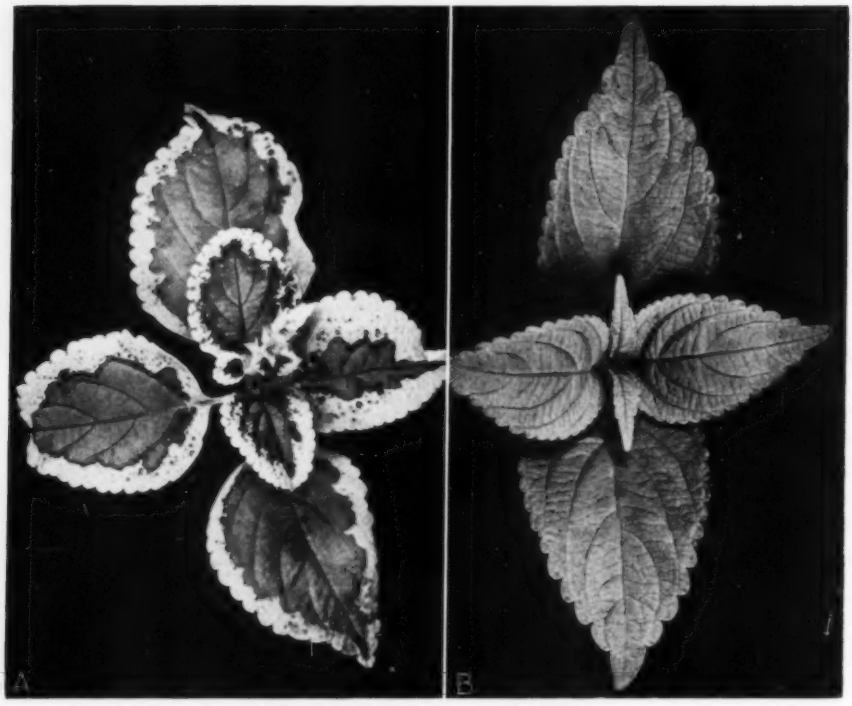
A—Leaves with purple upper and lower epidermis, as shown by: (1) the parent "Purple" plants, (2) three-fourths of their selfed progenies (Tables I and III; Figure 5), and (3) one-half of the progeny when backcrossed (Table II). *B*—Leaves with a dark brown center area and a dark green border on the upper epidermis and green lower epidermis, as shown by: (1) three-sixteenths of the selfed "Purple" progenies (Table III; Figure 5), (2) the male parent plant used in the backcross (Table II), and (3) one-half of the progeny obtained by crossing with the heterozygous "Purple" plant (Table II). A single pair of allelomorphs (*Pp*) are assumed to control the development of these patterns. (Figures 2-4, three-quarters natural size.)

As many as 200 Coleus have been listed as species. These species are described as annual or perennial herbs or small shrubs, and are reported to be found with varying frequency in Africa, Madagascar, the Malayan Archipelago, the East Indies, Australia, and the Philippine Islands.

The history of the cultivation of Coleus indicates that the commercial varieties, of which there may be more than 200, are probably descended from plants derived from crosses in which four of these species were used. At present it appears that the numerous commercial varieties of Coleus presumably carry the specific taxonomic characters of two of these four species.

The commercial varieties of Coleus show an impressive range of variation.

*The authors wish to acknowledge their indebtedness to several members of the Botany Department for their helpful suggestions and for greenhouse facilities.



LIGHT BROWNS AND GREENS

Figure 3

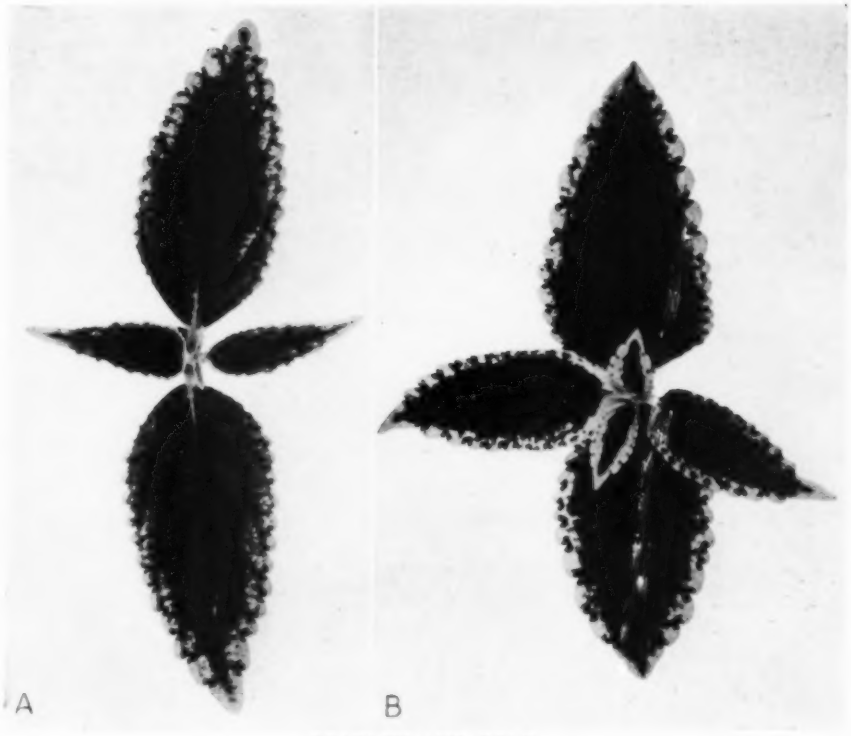
A—Leaves with a light brown center area and a light green border on the upper epidermis and green lower epidermis, as shown by one-sixteenth of the selfed "Purple" progenies (Table III; Figure 5). *B*—Leaves with yellow-green upper and lower epiderms, as shown by: (1) the parent Golden Bedder plants, and (2) three-fourths of their selfed progenies (Table IV; Figure 6).

This heterogeneity suggests that this plant should be extremely useful material for genetic experimentation. Variation of leaf color is the most obvious characteristic of Coleus which might attract the attention of students of genetics. The shape of the leaves and leaf margins are additional characteristics which show considerable variation.

The usefulness of Coleus as genetic material is enhanced by its production of large numbers of seed, a single flower stalk often bearing from one hundred to three hundred seeds, and by the fact that it can be propagated vegetatively.

Stout[7] concluded that in Coleus asexual and sexual reproduction are not fundamentally different in respect to extent and range of variation. He did not, however, formulate any genetic hypothesis, and hence did not draw conclusions concerning the mechanism of inheritance of the characteristics which he studied.

This study was made with particular reference to the inheritance of factors for leaf color in two varieties of *Coleus blumei*. Supplementary observations concerning additional characteristics of this species of Coleus are to be used for further genetic studies of the varieties of this and other species of Coleus.



SCARLET AND GOLD

Figure 4

A—Leaves with a scarlet center area and a golden yellow border, as shown by one-fourth of the selfed Golden Bedder offspring (Table IV; Figure 6), and which are practically indistinguishable from the leaves of plants of the "Gold Bound," another commercial variety (*B*). The results of selfing Golden Bedder plants are given in Table IV.

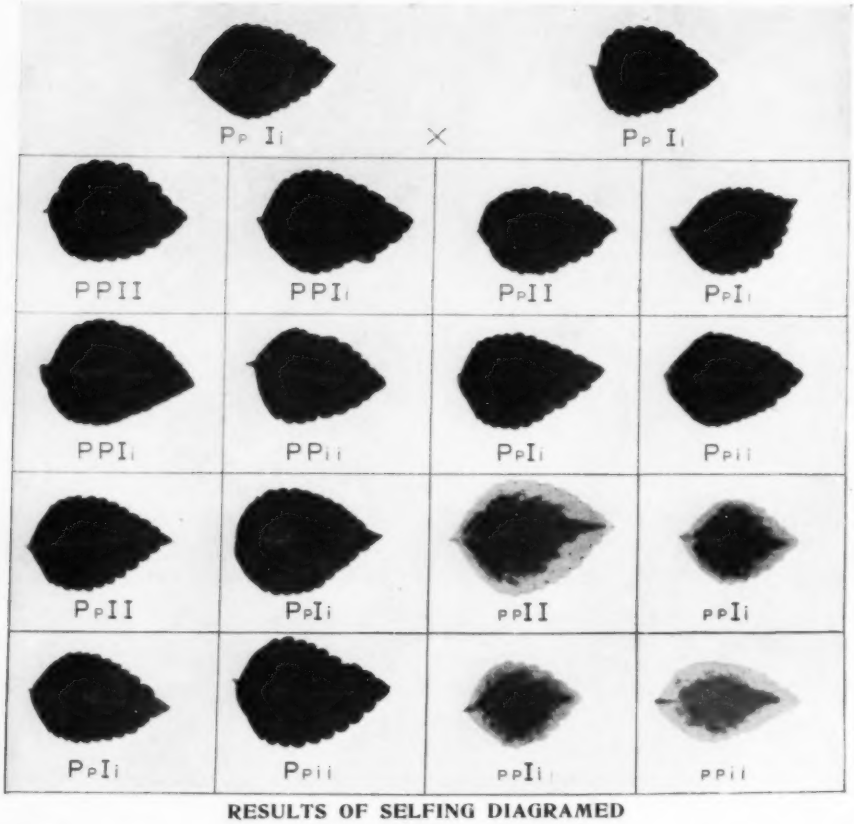
The first, known as the "Purple"* variety, arose from recombination in hybrid seed and has been propagated vegetatively at Ohio State University for four years. The second, Golden Bedder, a well known commercial variety, was purchased from a commercial green house, and has a history of ten years of vegetative propagation at this university. In neither of these have observable somatic mutations occurred during this time.

"Purple"

An analysis of the phenotypes obtained by selfing plants of the "Purple" variety (Figure 2*A*) with respect to the appearance of plants bearing leaves with purple upper and lower epidermis (Figure 2*A*) and leaves with a brown center area with a green border on the upper epidermis and green lower epidermis (Figure 1*B*) is given in Table I. For the sake of brevity the two phenotypes will be hereafter designated as "purple" and "pattern." These data are presented graphically in Figure 5.

These data suggest genetic behavior based upon a pair of allelomorphs with complete dominance for which the plants from which the selfed seed was obtained were heterozygous. The plants

*Since this phenotype arose from recombination in hybrid seed, and since none of the commercial varieties correspond to it, the authors have designated this variety as "Purple."



RESULTS OF SELFING DIAGRAMED

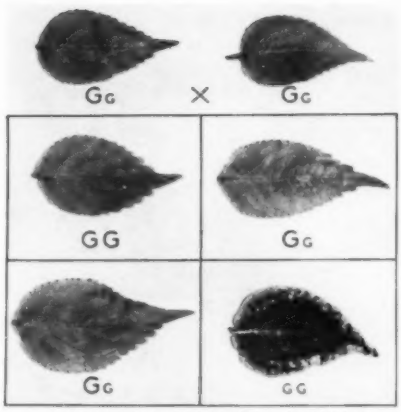
Figure 5

A checkerboard showing the probable distribution of genotypes and the observed distribution of phenotypes obtained by selfing "Purple" plants. This puts in brief graphic form the data which led to an hypothesis involving a 12:3:1 ratio of phenotypes. See Table III and Figures 2 and 3.

from which the selfed seed was obtained may be considered an F_1, and the phenotypes recorded in Table I may be considered an F_2. In testing this assumption a Chi-square (χ^2) value of 0.700 is obtained which with one degree of freedom has a probability which falls between .50 and .30. This indicates that the deviation of the observed values from the theoretical values is not significant and that one may confidenly hypothesize genetic behavior based upon one pair of allelomorphs with complete dominance.

In order to test this hypothesis, plants bearing purple leaves were backcrossed with plants bearing pattern leaves. In this backcross the plants with purple leaves were the female parents and the plants with pattern leaves were the male parents. An analysis with respect to the expected phenotypes resulting from this cross is presented in Table II (Figure 2).

In testing these results, a Chi-square (χ^2) value of 3.644 is obtained. This value with one degree of freedom has a probability which lies slightly above .05 and indicates that an hypothesis involving one pair of allelomorphs with com-



"GOLDEN BEDDER" "SELFS"

Figure 6

A checkerboard showing the probable distribution of genotypes and the observed distribution of phenotypes obtained by selfing Golden Bedder plants. See Table IV and Figures 3 and 4.

plete dominance is tenable, since the observed and predicted ratios do not show a significant deviation. This conclusion is, however, based upon one further assumption. The backcross data were obtained by using the purple plant as the female parent, and the pattern plant as the male parent; no data are at present available for the reciprocal cross. It must be assumed, therefore, that similar results would be obtained from a cross in which the purple plant was the male parent, and the pattern plant was the female parent.

The significance of the observation of a number of plants with pattern leaves and dilute chlorophyll pigmentation (Figure 3*A*) was not realized until after the plants resulting from seed samples 1-5 (Table I) had been destroyed. Observations with respect to this condition were made on the plants resulting from seed samples 6-11, inclusive (Table I); this analysis is given in Table III (Figures 2, 3, and 5).

These data suggest a two-factor cross with epistasis, which results in a 12:3:1 ratio of phenotypes. It may be hypothesized that the plants from which the selfed seed were obtained were heterozygous for two pairs of factors, one of which determined the purple and pattern phenotypes, the other of which determined the intense and dilute phenotypes, and the first of which was epistatic to the second. The plants from which the selfed seed was obtained may be considered an F_1, and the phenotypes recorded in Table III may be considered an F_2. Upon the basis of this assumption a Chi-square (χ^2) value of 0.263 is obtained, which, with two degrees of freedom, has a probability which falls between .90 and .80. Thus the observed values do not deviate significantly from those predicted upon the basis of the hypothesis that genetic behavior involving two independent pairs of allelomorphs with epistasis is involved in the production of the observed phenotypes.

Golden Bedder

A phenotypical analysis of the Golden Bedder offspring, obtained by selfing, with respect to green leaves (Figure 3*B*) and pattern leaves (Figure 4*A*) is given in Table IV. These data are graphically shown in Figure 6.

Upon the basis of these observations it may be hypothesized that the phenotypes which resulted from this cross were due to a pair of allelomorphs, which were present in the plants from which the seeds were obtained in the heterozygous condition. One may consider the plants from which these seeds were obtained an F_1, and the phenotypes recorded in Table IV may be considered an F_2.

Assuming genetic behavior based upon a pair of allelomorphs, with complete dominance, a Chi-square (χ^2) value of 0.338 is obtained which with one degree of freedom has a probability that falls between .70 and .50. Thus the deviation between observed and predicted ratios is not significant and one may confidently hypothesize one pair of allelomorphs with complete dominance to account for the observed phenotypes.

The backcross which would test this hypothesis has not yet been completed

and thus this hypothesis must be considered as purely tentative until the data from this cross, which would test the assumptions involved in the formulation of this hypothesis, are available and the observed phenotypic ratios checked by means of the usual Chi-square (χ^2) test.

An interesting and significant supplementary observation concerning the pattern offspring from this cross, is that this pattern phenotype is practically indistinguishable from the phenotype expressed by the commercial variety known as "Gold Bound" (Figure 4*B*).

Summary

Upon the basis of the genetic interpretation of the data presented in the foregoing analyses, it may be rather definitely concluded that the "Purple" variety of *Coleus blumei* is heterozygous for a pair of allelomorphs *P* and *p;* where *P* is the gene for purple leaves, and *p* is the gene for pattern leaves. The critical assumptions involved in this conclusion are that (1) the backcross data are rather insufficient, and (2) data from the reciprocal backcross are not yet available.

Statistically significant presumptive evidence indicates that the "Purple" variety of *Coleus blumei* is heterozygous for two pairs of factors, with epistasis, which manifest themselves phenotypically by the appearance of purple leaves, pattern leaves with intense chlorophyll, and pattern leaves with dilute chlorophyll. The additional pair of allelomorphs are *I* and *i;* where *I* is the gene for intense chlorophyll and *i* is the gene for dilute chlorophyll. Conclusive evidence of the validity of this hypothesis must be based upon backcross data obtained by crossing plants of the "Purple" variety with plants bearing pattern leaves with dilute chlorophyll, both reciprocal backcross matings being made.

The variety of *Coleus blumei* known as Golden Bedder is presumed to be heterozygous for a pair of allelomorphs *G* and *g;* where *G* is the gene for green leaves and *g* is the gene for pattern leaves. This assumption is at present being tested by means of a backcross in which both reciprocal matings were made.

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Table I. Progeny of Selfed "Purple" Plants.

Seed Sample	Phenotypes		Totals	
	Purple	Pattern	Purple	Pattern
1	12	5		
2	21	7		
3	29	14		
4	11	0		
5	63	21	580	207
6	30	27		
7	134	49		
8	45	8		
9	31	12		
10	75	26		
11	109	38		

Table II. Progeny of Backcross— ♀Purple × ♂Pattern.

Phenotypes		Total
Purple	Pattern	
43	27	70

Table III. Intense and dilute Pattern Among Progeny of Selfed "Purple" Plants.

Seed Sample	Phenotypes			Totals		
	Purple	Pattern, Intense	Pattern, Dilute	Purple	Pattern: Intense	Dilute
6	30	20	7			
7	134	34	15			
8	45	4	4			
9	31	8	4	444	111	49
10	75	18	8			
11	109	27	11			

Table IV. Progeny of Selfed "Golden Bedder" Plants.

Seed Sample	Phenotypes		Totals	
	Green	Pattern	Green	Pattern
1	4	1	47	14
2	43	13		

INTELLIGENCE, HEREDITY, AND SELECTION

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EVERY study that has been made, in whatever material and by whatever method, agrees in showing that bright children tend to come from bright parents, dull children from dull parents.

The intelligence of these children can not be separated artificially from the culture in which it develops. The relations of the two factors can be disentangled to some extent, however, by the study of twins and adopted children, and by the use of statistical techniques in measuring the influence of environmental factors.

Such studies have been numerous. They indicate that, in the conditions of everyday life, the child's inheritance has more to do with determining his level of intellect, than have the variations in culture to which he may be subjected; in other words, that his intellectual achievements are largely determined by the particular assortment of genes he has received from his parents.

All that is known of genetics suggests that the number of genes involved in producing "intelligence" must be very large. The fact that intelligence is distributed in a normal curve indicates that the effect of these genes is in a general way additive or cumulative. No important relationship of dominance is involved,—this conclusion is warranted by the fact that the correlation for IQ between sibs is about the same as the parent-offspring correlation, and that the correlation between inferior parent and offspring, and that between superior parent and offspring, are also the same.

Every one of the genes (of which there might easily be hundreds or thousands) involved in creating the basis of intelligence has at least one alternative form, in many cases perhaps several such alternatives. The man of high intelligence has had the good fortune to receive a large proportion of advantageous genes, and the most disadvantageous ones which he received are balanced by better selections elsewhere along the line. The man of low intelligence, on the other hand, has received a minimum of good choices and a maximum of the bad.

The possibility can be understood more easily by analogy with a pack of cards, limited for the sake of illustration to two suits. A man may get all clubs, and have an excellent hand; he may get all spades, and have an equally good hand. He may, however, get a mixture of clubs and spades so badly assorted for his purpose that he can not take a single trick. Each man gets the same number of cards; his fate depends on just which cards he gets out of the assortment.

With hundreds or thousands of genes and their various alternatives from which to draw, it is evident that Nature can deal out a large variety of hands, some of which will be so rare that they may not appear once in a thousand years.

These genes are not distributed evenly (except in number) among various families. In some families, because of a long series of marriages between the possessors of favorable combinations of genes, some of the undesirable alternatives are wholly lacking in the germ-cells of the men and women, and will not reappear unless and until they are again brought into the family by an unwise marriage.

Other families, by virtue of generations of bad marriages, have accumulated a maximum of undesirable genes and a minimum of good ones. Their children have to draw from this assortment, and are more likely than not to receive bad combinations themselves.

With all these genes and their alternatives, it is also evident that there is almost no limit to the possibility of building up, by selection, better assortments of inherited units. This has been done to a limited extent for short periods of

time, but mankind is such a hybrid, and so little care is taken in the selection of mates with the highest hereditary qualities, that valuable combinations which are built up are likely to be dissipated after a few generations at most.

If a super-man could arrange human marriages at will, in the way that a plant or animal breeder does, he could produce results that by present standards are almost incredible. Humanly speaking, there are almost no limits to the possibilities of selection for intelligence. A race could be produced, the lowest individual of which would have a higher IQ than Aristotle, Goethe, or Newton.

Contrariwise, selection might be applied at the other end and a race produced, the brightest individual of which would be inferior to the imbecile of present-day society. Selection in a negative direction would encounter a limiting factor, when the subjects became too stupid to live; but selection in a positive direction seems to have no natural limit, by comparison with present standards.

A comparable result has been produced by selection in other species. A familiar example is the experiment reported[1] by Floyd L. Winter in which corn was selected through 28 generations (equivalent selection in man would cover less than a thousand years) for high and low protein content and high and low oil content of the kernels. The frequency polygons of oil content (the findings for protein were similar) during the last few years of the experiment did not overlap at either end the frequency polygon of the material with which the experiment started. In other words, the minimum value in the high oil race during the last five years was considerably higher than the maximum value found during the first four years and, on the other hand, the maximum value in the low oil race was even more markedly below the lowest in the first four years.

Moreover, there was no diminution with the years, in the rate of improvement. In other words, the limit of improvement was not even in sight. Obviously, there would be a physiological limit: a kernel could not be produced which consisted of 100% oil or protein as the case might be. This limit is somewhat analogous to the one suggested above for the production of a race of idiots. But compared with the average range known today, the limits of improvement are literally "out of sight."

A closer analogy to the human problem is furnished by R. C. Tryon's selection of rats for low and high intelligence.[2] The measurement of intelligence in this case is the ability to go through a maze,—a simple and widely-used test. After 15 rat generations (equivalent in human history to the time that has elapsed since Columbus reached America) two groups were produced, of high and low intelligence respectively, whose polygons of frequency do not overlap. The dullest rat among the superior is better than the best among the inferior; and again there is no evidence that the limit of selection is being reached.

It is not suggested that the same sort of results can follow the application of eugenic measures to mankind, in any calculable time. Marriage selection, and the social conditions surrounding parenthood in human society, are,—fortunately,—very different from the conditions created in the genetics laboratory. But it seems clear that there is no theoretical genetic hindrance to the immense improvement or the immense deterioration of the human species, according to the kind of selection that is practiced.

The kind of selection that is actually taking place in the United States is too well known to need description. Conditions in other states are probably much the same as in California. In this state, the family that sends a child to the state university averages two living children; the family that sends a child to the state home for the feeble-minded averages five living children.

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[2] Tryon, Robert C. "Individual differences," in Moss, F. *Comparative Psychology*, 429-430. (This account covers only the first eight generations of selection.)

OCCURRENCE OF ALBINO SEEDLINGS IN VICTORIA OATS

D. C. SMITH*

ATTENTION has been directed frequently to the appearance of chlorophyll deficiencies in crop plants. One of the most common of such abnormalities is albino seedlings. Halsted and Kelsey[8] reported such plants in maize in 1904. Demerec[7] later found factors for albino seedling types in maize to be inherited according to simple single, duplicate and triplicate factor explanations. Albinos in maize have been observed by many investigators. Nilsson-Ehle and others, cited by Daane[5] reported albino seedlings in barley and the character has been observed to segregate according to 3:1 and 9:7 ratios. Nilsson-Ehle[11] later noted the existence of three independent factors for white seedlings in different varieties of barley. Wiebe[14] obtained segregations of seedlings agreeing closely to a three normal to one albino ratio. More recently others have reported existence of albino seedlings in barley progenies. Brewbaker[1] noted albino seedlings in progenies of inbred rye. Smith and Harrington[13] obtained 3:1, 15:1 and 63:1 ratios of normal to albino seedlings in F_3 lines of a Vernal (*Triticum dicoccum*) × Marquis (*T. vulgare*) cross. Neatby[10] reported the occurrence of an albino seedling in a second generation progeny from an F_5 yellow mutant plant appearing in a cross of common wheats. Codd[2] observed segregation of 63 green to one albino seedling in hybrid generations of rice plants. According to Codd albino seedlings in rice had been previously reported by others. Conner and Karper[4] noted the separation of seedlings derived from a single head of Blackhull kafir into greens, virescent whites and

ALBINO OAT SEEDLINGS

Figure 7

A pot of 29 seedlings of the Victoria Oat variety produced eight albinos. Since no chlorophyll deficiencies were noted in 7,000 other pot cultures, this represents a rather rare event.

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albinos. De Haan[6] presented a good summary of the previous literature on plant albinism in 1933. In recent years observation of albinos in cereal and other plants has been fairly frequent.

Albino seedlings in oats have been reported rarely. This may be due, in part, to the polyploid nature of the commonly grown species. Zhegalov, cited by De Haan[6], appears to have been the first to observe albino seedlings in the genus Avena. Coffman et al[3] noted white seedlings in the progeny of a white striped plant of the Burt variety. Additional albino types appeared in progenies of striped plants derived from the original one. Philp[12] reported albino seedlings among progeny of a cross between *Avena sativa gigantica* and *Avena fatua*. Segregations were somewhat irregular due to variations in chromosome numbers, though some groups gave ratios of three green to one albino. Variegated plants always segregated an excess of albinos in their progenies. Love and Craig[9] described chlorophyll abnormalities in hybrid progenies and designated certain plants as "yellow or white" but did not refer to "white" or "albino" seedlings though these may have been observed.

In 1932-1933, while studying reactions of oat seedlings to stem and crown rusts, approximately 7,000 pots of plants were grown in greenhouse cultures at the Minnesota Experiment Station. Each pot contained from 20 to 40 seedlings. Strains tested included standard varieties and segregates from several crosses. Among the seedlings grown chlorophyll abnormalities were noted but once.

Potted seedlings of a single plant progeny of the variety Victoria (C. I. 2401)* are shown in Figure 7. Twenty-nine plants included eight albinos. Seventy-eight additional seedlings from seeds of the same plant consisted of 65 normal and 13 albino types. No striped seedlings were noted. The parent plant was not observed to be striped though a very fine pattern could have been overlooked in selection. Since progeny tests of the apparently normal seedlings were not made the inheritance of the albino character in this instance is uncertain though the data suggest a ratio of three normal to one albino.

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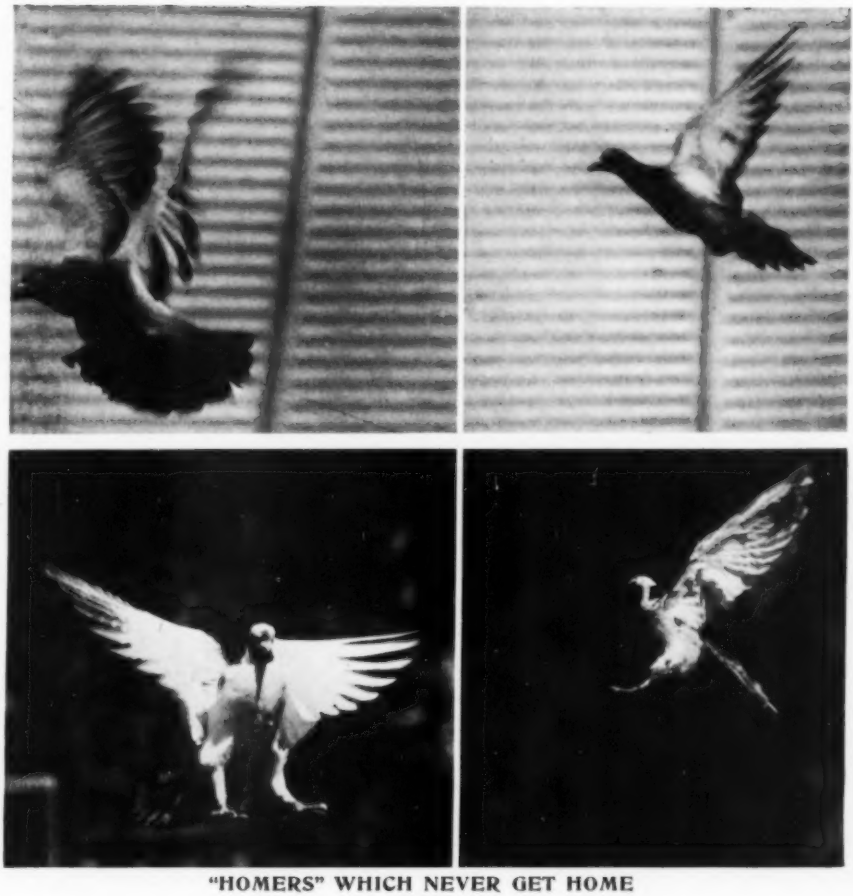
"CLUMSY" PIGEONS*

W. F. HOLLANDER



"HOMERS" WHICH NEVER GET HOME

Figure 8

"Clumsy" pigeons fly only gropingly and as a last resort, crash into walls, or come to grief in other unexpected ways. They are shown in flight (below) compared with normal homing pigeons (above). Their disability seems to be due to defective vision, though they can see a little. The "clumsy" strain has been isolated from normal homing pigeons. On account of the ease of handling, these "non-homing homers" may have considerable utility in the laboratory.

HOMING pigeons unable to locate home a few yards away are of no use as messengers, but may have unusual possibilities as laboratory birds. About 30 such pigeons have been produced, all in a single family line of Homers whose color inheritance was being analyzed. The original ancestors

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of these "homeless homers" were all normal.

In action the abnormal birds have earned the name "clumsy." They grope their way about, walk off precipices, crash into walls during flight, fumble their food, and would be quite incapable of surviving in the wild state. Their behavior resembles that of a blind pigeon, but they can see to some extent.

The clumsy birds are very easy to handle since they fly only on considerable provocation, and even then are retrieved without difficulty. In Figure 8 a normal pigeon (above) is seen making a bee-line for a goal, while a clumsy specimen (below), after being tossed up, flies cautiously with landing gear outstretched in mid-air. Hesitancy to make rapid movements seems to be the result of painful experience; at any rate they are docile laboratory subjects, and would probably make excellent decoys.

Since the trait first appeared in offspring of normal pigeons, it was suspected of being a simple recessive. Further breeding data confirmed the suspicion; outcrosses yielded only normal young, while matings of clumsy with clumsy produced only clumsy offspring, as shown in Table 1. So far as combinations have been obtained, no association or interaction of the factor for clumsy with other known factors has been detected.

Several of the clumsy pigeons have been sacrificed in order that a search for abnormalities of the eye or brain could be made. The brains appeared to be identical with those of normal controls; the eyes also were superficially quite normal. Good microscopic preparations of the retina were made after fixation with Bouin's fluid and embedding in paraffin; Ehrlich's hematoxylin was used for staining. In the layer of rods and cones the clumsy material showed more irregularity of transverse markings than did the normal. Osmic fixation was next tried in an attempt to preserve the brilliantly colored oil droplets of this retinal layer, but without success because of crumbling and blackening of the tissue.

Frozen sections and smears of fresh adult retina revealed that the oil droplets were less evenly arranged in the clumsy than in the normal, and there were apparently fewer red droplets. Moreover, none of the rods were stippled red as in the normal. Further study has not been attempted; the technique employed by Walls[1] should be helpful. However, it seems that a visual defect is responsible for the clumsy behavior.

It is to be hoped that this valuable and interesting unit character of the pigeon will become more widely known.

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TABLE I. Breeding data showing inheritance of "clumsy" trait.

Mating	Parents ♂	Phenotype	Parents ♀	Phenotype	Offspring Normal	Offspring Clumsy
Segregation from Normal Parents						
1-33-51	8-31-5	normal	8-31-4	normal	9	1
2697	26068A	normal	26060	normal	5	3
27730	26068N	normal	26077F	normal	10	3
27704	26068	normal	27000	normal	16	7
Total					40	14
Expected					42	14
Clumsy X Normal						
2629	2784E	clumsy	26810	normal	18	0
D707	2697E	clumsy	D3634	normal	5	0
D844	2697E	clumsy	D170.3	normal	11	0
Total					34	0
Expected					34	0
Back-cross to Clumsy						
2900	2697E	clumsy	D787A	normal	4	4
Expected					4	4
Clumsy X Clumsy						
2808	2697J	clumsy	2697N	clumsy	0	8
2881	27041	clumsy	26068A	clumsy	0	2
Total					0	10
Expected					0	10

◆

Fewer Children

A million fewer children entered elementary schools this fall, than in 1930 (the peak year), according to the Office of Education. Births in the United States are now dropping at the rate of about 50,000 a year and deaths increasing by about 20,000 a year. Growth of the population is likely to end as early as 1945, federal statisticians calculate. After that, the total population will begin to decline, slowly at first. Looking ahead 50 years, Dr. O. E. Baker of the Department of Agriculture says "there may be only one-third as many children in the nation as now, and only half as many women of child-bearing age. There will be nearly three times as many old people."

SABLE COAT COLOR IN COCKERS

JAMES MCI. PHILLIPS

A SABLE COCKER SPANIEL

Figure 9

Sable is an unusual color in spaniels. It is due to a mixture of red and yellow hair with black or black-banded hairs. Both parents of this bitch were black and she had no sable or brindle ancestors for several generations. By a black dog she has had one sable pup (Figure 10).

THE term sable is applied by dog fanciers to mixtures of red or yellow hair with those which are black, or black banded with red or yellow. The breeds in which this is most frequently found are all long haired and include the Collies,[3] Shetland Sheep Dogs, Pekingese,[8] and rough St. Bernards.[2] The amount of black is extremely variable, some specimens of sable dogs at first glance appearing to be almost pure red or yellow, but closer examination will reveal some of the black and banded black hairs on the face, head and ears, especially on the muzzle near the nose, about the eyes, on the edges of the ears, and perhaps on the rump. Some dogs have so much black in the coat that the sable is very dark, but even a cursory examination will show the telltale yellow and banded hairs. Intermediate color patterns of great variety occur.

Collies are homozygous for the recessive black and tan pattern factor so that even in the lightest shades of sable the characteristic "thumb marks" over the eyes and the cheek patches are in clean contrast to the darker areas of sable surrounding them.

In the Smooth Collie the black does not occur in streaks but nevertheless the color is often referred to as brindle. This is probably erroneous as the color is certainly identical with the sable of the rough variety. The St. Bernard does not show or carry the bicolor black and tan pattern, and the dark hairs are often arranged as brindle stripes. The sable of all the other breeds mentioned, except the Pekingese, like agouti in rodents, is dominant

over black or black and tan,[5] and would seem to be very similar to the dominant red of short-haired hounds such as the Dachshunds and Foxhounds.[1]

In the St. Bernards the amount of black in the red is extremely variable especially on the head. In some dogs practically the entire head is black, while in others there is no black excepting a small amount on the muzzle. The amount of black on the body is equally variable. These color patterns due to various combinations of black and yellow are very like those seen in the tan and brindle Danes.

Whitney[9] crossed a St. Bernard with a brindle French Bull and all the F_1 resembled the St. Bernard in color. Several of his crosses of St. Bernard and black Newfoundland[8] showed black to be dominant. This would indicate that the color of the St. Bernard is not a true dominant sable but that it is similar in inheritance to the black-masked fawn and the brindle of the Great Dane.

In Pekingese the black and tan pattern is present in some specimens and absent in others, and both the dominant Collie type and the recessive St. Bernard type of sable are found.

Orthodox coat colors in Cockers do not include brindle or sable, or any of the agouti or chinchilla types of color, the Standard recognizing only self black, self liver, any shade of self red or yellow, black and tan and liver and tan, and any of these colors with the recessive piebald white splashing.

The Cocker bitch under consideration was bred by Mr. Landaker of Cincinnati, Ohio, and is owned by Mrs. Walter Elliott of Duncan Falls, Ohio. She is dark red with many black hairs distributed rather evenly through the coat, mostly on the dorsal surfaces. They are most numerous on the face and around the edges of the ears. None of the hairs is banded but each is jet black throughout its entire length. The eyes and nose are black. The black hairs are all longer than the red, in some cases nearly one-third longer. Both of her parents are black. There were several red litter mates, but she

A SABLE-AND-BUFF
Figure 10

Son of a sable bitch (Figure 9) by a black dog heterozygous for the black and tan tricolor pattern. In addition to the sabling, this dog has the tan areas of a black and tan pattern. The recessive nature of the sable coat in cockers makes it more closely resemble the inheritance of the pattern in St. Bernards and Great Danes than in collies.

was the only one to show this pattern. The black hairs were not arranged in bands but were scattered uniformly through the coat when she was whelped and her puppy coat was short. None of her ancestors was sable or brindle, and for several generations none had ever been known to throw sable. Mated to a black dog, heterozygous for the black and tan bicolor pattern, and which also carries buff as a recessive, she threw one black and three reds varying from medium to dark red, and one rather light red with very heavy sabling, which in addition to the sable pattern shows areas of clear buff which correspond exactly to the position of the tan areas in a "bicolor black and tan." The black hair in this dog also is much longer than the buff. Another

mating to a solid homozygous black threw only blacks as one would expect, but contrary to expectation a third mating with a dark red with black nose threw four red pups, one dark and three medium, but no sables. The black dog which threw the sable was a total outcross and had never been known to throw a sable, nor had any of his ancestors.

It would therefore appear that this color, though phenotypically resembling the sable of Collies is genotypically quite different, and even though the black does not occur in streaks but is uniformly mixed with the red, on the bodies of the dogs, it is much more closely related to the sable of St. Bernards and the brindle of Great Danes,[4] Greyhounds,[7] etc., which are recessive to self black but dominant over red, fawn, tan, etc.

I have heard of two other Cockers of this color whose description tallies exactly. Both of these were the product of red by black matings, and came from stock which had never thrown brindle or sable. This sable coloring is quite common in certain strains of Springer Spaniels, in which breed it appears as sable patches on piebald dogs, and from the figures which I have been able to obtain it seems to be recessive to black and dominant over red and yellow. In Springers red and white and sable and white are unpopular colors, consequently most of them are destroyed at birth, but they keep recurring from the black and white stock.

Whether these examples cited in Cockers are the result of recessive "throwbacks" or arose from three individual mutations it is impossible to say, but they were found in three very remotely related strains of the breed.

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A Memorial Volume to William Herbert

Volume four of *Herbertia*,* issued in 1937 by the American Amaryllis Society, is "dedicated to the memory of The Hon. and Very Rev. William Herbert, 1778-1847, Dean of Manchester, in celebration of the 100th anniversary of the publication of his enduring work—*Amaryllidaceae* in 1837." In addition to the technical articles which usually appear in this yearbook, volume four contains a portrait of Dean Herbert, his biography (15 pp.) by Arthington Worsley, a short historical paper, *The early hybridizers and the origin of genetics*, by C. D. Darlington, *A Review of chromosome numbers in the Hemerocallideae, Alstroemeriales and Amaryllidales* by W. S. Flory and S. H. Yarnell, and a reprint from the *Amaryllidaceae* of Herbert's famous chapter, *On crosses and hybrid intermixtures in vegetables.*

This chapter is perhaps the best known of Dean Herbert's contributions to plant genetics. Published twenty-two years before Darwin's *Origin of Species*, it contained the statement that "there is no real or natural line of differences between species and permanent descendible variety, as the terms have been applied by all botanists," and thus we are justified in listing Herbert with the pre-Darwinian evolutionists.

**Herbertia* Vol. IV, 272 pp., edited by Hamilton P. Traub, published by the American Amaryllis Society, Orlando, Florida, 1937, price $4.25.

The conclusions drawn by Herbert from his genetic experiments show how far he was in advance of his time. He noted that the fertility or sterility of the hybrid offspring does not depend upon the original diversity of the parental stocks, but upon their constitutional rather than their botanical affinities. He definitely rejected adaptive modifications to environmental changes by individual plants and suggested that hardy varieties originated "by the accidental alteration of constitution in some particular seedling." Indeed, when we read Herbert's discussion of acclimatization, we are struck by the fact that he seems actually to have toyed with the idea of natural selection.

The American Amaryllis Society is to be congratulated on their memorial to one of the earlier and abler plant geneticists.

CONWAY ZIRKLE.
University of Pennsylvania

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Genetics for Animal Breeders

This 110-page booklet* by Dr. Krallinger, Professor of Applied Genetics and Animal Breeding at the University of Breslau, Germany, appears in the series of books on different phases of animal breeding edited by Professor W. Zorn, of the same university. It assumes that the breeders of livestock in Germany, for whom it is intended, are already familiar with the general principles of heredity and undertakes to bring them up-to-date by reviewing recent additions to the knowledge of heredity in domestic animals and methods of utilizing that knowledge in practical animal breeding.

Thirty pages (two of the six chapters in the book) are devoted to a summary of the genetics of color, and of characters affecting the hair, feathers, skeleton and other parts of the body. These are well illustrated. In discussing the more important quantitative characters (Chapter III) the author gives his readers at the outset an example of how such characters behave in inheritance and goes into considerable detail concerning body weight, growth, rate of fattening, fertility, milk production and wool production. The two chapters on methods of keeping records and systems of breeding are probably the most useful in the book since they point out clearly that the old system of evaluating an animal from its pedigree is inadequate. A workable system is outlined whereby a breeder can record production, mortality and fertility, utilize the progeny test and simplify the system to meet the special conditions in which it must be operated.

The lesson, though briefly told, is made clear by the use of fifty-three illustrations, a short glossary of genetic terms and an index. The fact that it is printed in German script will probably be much less of a handicap to the people for whom it is intended than to this reviewer.

F. B. HUTT.
Cornell University.

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A Roumanian Eugenics Journal

SIR:

In the August, 1937, issue of your very valuable Journal (pages 271-272), appeared the statement, that the "Evgenika" from Jugoslavia is the only journal in this line from all Balkan States.

For the sake of truth we wish to inform you that the "Buletinul Eugenic si Biopolitic" is in its eighth year.

We would be very much indebted to you if you will be so kind as to give the necessary correction.

Institutul Igiena, DR. I. MOLDOVAN
Cluj, Roumania.

The Editor is glad to stand corrected. Information regarding other publications in this field will be appreciated.

*KRALLINGER, H. F., *Angewandte Vererbungslehre für Tierzüchter* (Applied Genetics for Animal Breeders). Eugen Ulmer, Stuttgart-S., Olgastrasse 83. 1937.

"NATIONAL" EUGENICS

As An Element of Race-National Religion

TO Sir Francis Galton ideas of "race" and "nation" were highly sentimental, tightly interwoven, and frequently synonymous. For him the Eugenic work of improving the germplasm of his own "race-state" acquired the spiritual glow of a religious obligation.

Said Karl Pearson: *"*"*Galton was in the first place essentially an Englishman.* His wide experience of travel seemed only to have *confirmed his love for his own race;* he did not speak readily, he did not even read with ease and pleasure foreign languages. He *would not allow the word 'national' to be omitted from his definition of Eugenics.*"

"Do this and *your nation* shall not perish—was Galton's crede, for to him in the last years of his life *Eugenics had grown to be a faith. Eugenics,* he said, *must become a religious belief.*"

Pearson says elsewhere, *"Eugenics must from this aspect be essentially national,* and *Eugenics as a social policy will vary* according as you deal with Frenchmen, or Japanese, with Englishmen or Jews."

By recalling these once prevalent views upon the scope and application of eugenics, Dr. Ottmar Freiherr von Verschuer's *Erbpathologie*† should not come as a shock to those who now prefer to think in terms of mankind as a whole, or in terms of individual differences within "races," rather than in terms of political subdivisions, for von Verschuer's book is designed for the sole purpose of preserving and improving the German ideal, his project being considered as a national political problem, and having the status of a religion.

That Dr. von Verschuer adopts completely Galton's race-national views, which happen to fit perfectly into the Nazi scheme of things, is evidenced by the following translated quotations:

In the present day racial, national-socialist State the problem of state medicine is much broader to the physician. By a "people" we mean a spiritual and biological unity. That we are again a spiritually united people we thank our Führer Adolf Hitler. It is the duty of every German to contribute according to the best of his ability, that the unity of purpose, thought and convictions of our people are preserved and will evermore be newly strengthened.

Our people is also a biological entity. With blood ties is each individual bound to parents, grandparents, children, siblings, cousins and other relatives into one clan. If we could follow the inheritance lines still further as church books, and other sources permit, one could arrive at clear proof that the German people forms one great relationship, a blood society, if we except those marked by the immigration of foreign races. This biological unity of people will be known as the "people-body." It will be considered in its totality, its articulation, the different kinds of parts and the relationship of all to the resulting expression.

The reality, the unchangeableness, and the permanence of the "people-body" represents for us not the sum of single men but rather of *hereditary endowment,* that as a stream flows through the generations and in each person builds an individual entity by the combining of parental traits.

The hereditary endowment of a man may be understood however, only if the family and the race from which he stems is known. The new problem of state medicine is today the treatment of the "people-body" through the conserving and carrying on of the sound inheritance, by the elimination of diseased inheritance and by conservation of the *racial individuality* of our people—through genetic development and race-culture.

The "people-body" is principally menaced by four dangers:

1. Destruction through restricted selection.
2. Destruction through unfavorable selection.

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*All italics are the reviewers.

†VON VERSCHUER, OTMAR FREIHERR. *Erbpathologie.* Theodor Steinkoff, Dresden and Leipzig. 1937.

3. Injuring of the inherited endowment.
4. Racial foreignizing.

* * * *

Immigrants of foreign races bring in foreign hereditary endowments. Should they get into the people's hereditary-seed-stocks, the "people-body" will be changed thereby. The individuality of the German people is imperiled when the biological seed-stocks are no longer alike. To hold German cultural and spiritual inheritance in its individuality, to give to it living form and evermore to develop it anew includes the concept of the hereditary endowment, that in former times it had biological significance, and that it must be preserved in order to insure a greater future. Ancient civilization was destroyed through the death of the Greek and Roman races and through foreign immigation. Today we possess a knowledge of the biological laws upon which the life of a people depends. We believe therefor in the future of our people and against all thoughts of decay.

The national socialist state has come to grips with terrific might in the struggle against those dangers which menace the "people-body." The first was the battle against racial foreignization by the Jews. The racial separation between Germans and Jews was carried out principally through the Reich Citizens Law. The racial separation is guaranteed through the Law for Protection of German Blood.

It is probably quite as difficult for Dr. von Verschuer to close his eyes to the many diverse strains of blood that mingle within Germany's political boundaries as it would have been for Galton to have denied the Angle, Saxon, Jute, Norwegian, Dane, Pict, Scot, Irish, Norman, Roman, Phoenecian and other bloods that flow in the English.

But nevertheless, from the quotations of Pearson given above, it seems that it was possible for both Galton and Pearson to think of the English as a race. I imagine that in like fashion von Verschuer does not ignore original stocks completely, but considers them sufficiently blended for the purpose of a German racial ideal. The Japanese have developed a similar race consciousness. They claim to belong to the Yamato race, but there are many biotypes among them undoubtedly derived from diverse origins. For political purposes, men of the street in London, Berlin, and in Tokyo may easily be made race-conscious and only the uninspired biologists will quibble about the actuality of the wishes on which are based these claims to race-purity.

Dr. von Verschuer takes up the historical aspects of the study of human genetics, the nature of eugenic problems and the discussion of general heredopathology. He discusses simple dominants, recessives, sex-linked characters, multiple factors, linkage. He considers multiple allels in predisposition to disease and the phenotypic manifestation of hereditary tendencies. He treats the influence of the environment and the coöperative action of hereditary tendencies to produce genetic variability.

He deals with hereditary tendencies and developmental failure, constitution, disposition, organic inferiority, lethal factors, inbreeding, race mixtures, race pathology.

There is a chapter on special inherited pathology which takes up neurological defects, insanities, inherited diatheses, disease of the internal organs, bacteriological diseases, anomalies of body form, skin disease and defects of eyes, ears, nose and throat.

The final chapter is upon the application of heredo-pathology to medicine. Here is considered etiology, pathogenesis, therapy, medico-genetic appraising and eugenic advice. It includes a consideration of the percentages and distribution of tainted germplasm, the degree of hereditary damage, the biogenetic solution, education in bio-genetics and the tracing of discent.

Unfortunately, there is a paucity of photographs, which condition always limits the usefulness of such a book in the hands of the intelligent lay-public not familiar with many of the hereditary conditions described.

However, *Erbpathologie* is well suited to its purpose as a text for physicians and medical students in the Nazi state. Aside from its ideals of achieving and maintaining the phantasy of race purity, it might well serve as a model for American texts on medico-genetics.

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THE PATIENT AND THE WEATHER

A Study of How the Atmospheric Environment Affects the Human Organism

IN the Introduction to the first volume* of his work concerning "The Patient and the Weather" Petersen complains that medicine is being taught today as a "science of death." He says: "In the impressionable first two years of the medical curriculum we begin with the cadaver and teach our students innumerable names that must be attached to still objects. Every association means something that is fixed, at rest, immutable. And having been so conditioned in memory, the vast majority of medical men, in later life, think not in terms of constant motion, but in terms of congealed form." Similarly with histology, with pathology, even with physiological chemistry. The point of this argument is not that present methods of training can be changed easily, nor that details are unessential, but that insight into the causal relationships and progress in understanding of disease depend on analysis in dynamic terms and on a visualization of the ever changing pattern produced by currents and cross-currents of physiological functioning.

Much the same can be said with reference to all sciences which are concerned with living things. In all of them we are confronted with the intricate interdependence of different parts of organisms, constantly called into play by external agencies. It is in this respect that Petersen's work may be of greatest interest to geneticists. The usual method of testing experimentally the effects of environmental factors by single-step changes, though in most cases essential for obtaining clear results, nevertheless is conducive to leading the experimenter to a much too static conception of actual situations. To conditions as simple as a change in temperature of the surroundings from one level to another an organism may respond with a long chain of direct and indirect responses and adjustments. We know little about the effects on organisms of long-continued fluctuations of temperature, as they are frequently encountered in natural environments; still less is known about the rôle of temperature changes under different conditions of humidity, of barometric pressure, of air currents, or of these and other climatological factors by themselves. To study the effects of events as complex as "weather" in general appears an almost impossible task. Yet, this is the program which the author of this work has set for himself with regard to human diseases and ailments of all kinds.

The first volume of the series (vol. I, Part 1) gives a general introduction to the problems of medical climatology. The teachings of Hippocrates are reviewed in some detail. There follow discussions of the most important climatic facts concerning the North American continent; of differences between whites and negroes with regard to physical and mental development; of the frequency of incidence of various diseases in different parts of the United States, with special reference to the storm tracks; and of some other related problems. In the next volume (vol. I, Part 2) the author gives a detailed discussion of the atmospheric environment in this country (such as cyclonic circulation, atmospheric pressure, temperature, humidity, sunlight, ionization, and so on) and of the reactions of the human organism to these factors (effects on different constitution-

*W. F. PETERSEN. *The Patient and the Weather.* Vol. I, Part 1, The Footprint of Asclepius. XX, 127 pp., 94 figs. Edward Brothers, Ann Arbor, Mich. $3.75. Vol. I, Part 2, Autonomic Integration. XXX, 781 pp., 366 figs. Ibid. $9.00. Vol. IV, Part 1, Organic Disease, Cardio-vascular-renal Disease XXXIV, 633 pp., 443 figs. Ibid. $10.00.

al types; on weight, basal metabolism, leucocytes, oxydation and body temperature, blood pressure and pulse rate, digestion and excretion, mental well-being, growth, etc.). This is followed by detailed accounts of the responses of individual patients to a variety of conditions. The second and third volumes of Petersen's work have already been reviewed in this Journal (vol. 27, pp. 83-84). The most recent part (vol. IV, Part 1) deals with the cardio-vascular-renal disease complex (myocarditis, arteriosclerosis, nephritis, endocarditis, etc.). A great number of case histories are analyzed in detail with reference to meteorographic conditions.

An immense amount of material has been assembled in these volumes, and one cannot but be impressed with the wealth of evidence in favor of the author's theme that climatic conditions play a major part in the contracting of, and the subsequent course of, a great variety of human diseases. This is only a beginning in a vast new field of research. Inasmuch as these studies deal with the reactions of organisms to their environment, they are of considerable interest to geneticists. WALTER LANDAUER.

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A SAN LOUIS REY OF PROSTITUTION

THORNTON Wilder wrote a best seller a few years ago in which a priest in an isolated community of Peru attempted to evolve statistical proof of the Divine Plan by a detailed study of the lives of a group of his parishioners. The result was not altogether conclusive. The "test case" hinged upon the determination of why certain people found themselves on a bridge which fell, while others crossed over the river in a boat and lived. Some of those who died seemed to be the ones who should have lived, and vice versa. Friar Joseph, whose life work this study was, then set up a rating scale of excellence of his parishioners, and of their usefulness in the community. An attempt to relate virtue and utility in a pioneer community seemed to bristle with negative correlations.

A genetic approach along San Louis Rey lines of the problems of prostitution has recently been given to the world from Copenhagen. The Danish law requires that all prostitutes be registered, so that it is possible to obtain fairly complete lists of the practitioners of the oldest profession in a given city. Dr. Tage Kemp utilized this material to make a detailed study to determine whether extrinsic or intrinsic factors were most potent in the recruitment of prostitutes. A book of 250 pages is the result, which attempts to list the case histories and family histories of 530 women among those who constituted the official prostitutes in Copenhagen between 1931 and 1935.

A glance through the case histories is dreary reading indeed. If the "wages of sin" have not been death in these cases they certainly hardly qualify as more abundant life. Many of the selections prove the obvious fact that "Tobacco Roads" exist not only in depressed rural regions but in even more aggravated form in every large city as well. There is little enough of glamour and an abundance enough of disheartenment, grief, and futility to document a score of "problem plays."

This guidebook of the social evil obtained almost as little in the way of "answer" in evaluating human fate as Kemp's mythical prototype in Peru. Mental abnormality and psychological abberations there were in abundance—"only 29.4 per cent were mentally normal and without defective intelligence." The more obviously genetic conclusions which Kemp arrives at are thus put forth in his summary:

7. Genetic investigation of the collaterals

*KEMP, TAGE. Prostitution. An investigation of its causes, especially with regard to hereditary factors. Translated from the Danish by Elsie-Marie Werner Kornerup. Pp. 253. Price, D. Kr. 10.00. Levin & Munksgaard, Copenhagen. 1936.

of prostitutes revealed that alcoholism, criminality, suicide, oligophrenia, psychopathy and true insanity occurred extensively. In 65.5 per cent of the *propositae* one or more of these disease or abnormalities was found in at least one relative. The frequency with which alcoholism appears in the fathers (18.6 per cent), and prostitution among the sisters, is especially worth noting. About 11 per cent of the *propositae* had at least one sister who was a prostitute, and about 5 per cent of the *propositae's* sisters were prostitutes. The fact that in several cases both the mother and maternal grandmother were harlots, permits us to conclude that the total mental personality which especially predisposes to prostitution is frequently hereditary. This applies particularly to the less pronounced defects in intelligence (stupidity, mental debility) and psychopathy.

Two hundred and six of the *propositae* had children. There were 310 altogether and of these 73 per cent were illegitimate. Many of these children died in early childhood or else their fate is unknown.

Nine were feeble-minded and of these, two were idiots, three epileptics and one blind. Two children were dullards, seven showed psychopathic characteristics and three were prostitutes. 11 children had congenital syphilis; seven of these died before they reached the age of five years, but of the four who lived, two were feeble-minded and one an epileptic; of the mothers of these 11 children, three were feeble-minded, two pronounced dullards and five psychopaths.

Examination of a series of pedigrees showed feeble-mindedness to be hereditary in some considerable degree and in agreement with the well-known laws for the transmission of less severe oligophrenia, i. e. that the same grade and same form of feeble-mindedness usually occur in a given family. Psychopathy proved to be inherited according to more complicated rules and it was frequently found in families where there also were many cases of insanity and oligophrenia.

8. If we reflect on where and how widely eugenic sterilization could have been advantageously undertaken in these families, we come to the conclusion that the possibility of carrying out rational, effectual sterilisation on a firm scientific basis, on a certain social group such as is represented here, is in reality slight.

The possibility would be considerably enlarged if comprehensive eugenic registration and thorough mental hygiene were practised all over the country. Furthermore, we are in need of medico-genetic research to increase our knowledge of the laws according to which the above-mentioned diseases and abnormalities are inherited.

9. The childhood and youthful environment of the *propositae* was, on the whole, extremely bad. In some cases they grew up in such unfortunate surroundings or were exposed to such undesirable influence in childhood or led such unsettled lives, that unfavorable environmental conditions may be regarded as the actual cause of their becoming prostitutes. It is, however, seldom that this is so self-evident. As a rule it is usually more a question of the reaction of inadequate equipment under more or less disadvantageous environment. One-third of the *propositae* were not brought up at home but spent their childhood under troubled and shifting conditions. In more than two-thirds of the cases conditions were in some way or other unfavorable in childhood and youth. As a rule the homes were poor and the families large (on the average 6.7 siblings). Some of the *propositae*, however, came from fairly good homes and there are also cases in which a woman's undesirable tendencies come to the fore in spite of her having grown up in the best possible environment.

And so the answer emerges or fails to emerge, depending on our viewpoint. It is quite right to say that heredity *and* environment have combined to produce a pageant of blighted lives. Possibly in a goodly number of cases, a less hopeless environment would have produced a different result. Eugenic statesmanship could hardly subscribe to the fallacy that the problem could be solved by so simple an expedient as compulsory sterilization. Bad heredity and bad environment both work against the advancement of mankind, and it may be only a quibble to expend too much time trying to decide which works the faster. It is equally folly to continue to multiply the feebleminded and defective, or to demand that the normal attempt an impossible flowering to cultural perfection in a feeble-minded environment.

Possibly we are justified in cutting the Gordian knot: "what difference does it make whether the cause be heredity or environment when the end result is bad? Probably it is both in a majority of the cases. So long as we are statistically in the right we build for future generations." Unfortunately, such a program makes little appeal to humane beings. "Weighed in the balance and found wanting" may justify flaming handwriting on the wall, and apply very well in situations in which the shoe fits. "Weighed in a *crooked* balance and found wanting" would hardly be a crime in a straight world. To claim that all the "scales of achievement" today are certified by a supernatural department of weights and measures may only prove

our stupidity or callousness. "There but for the grace of God go I," would need to be hedged somewhat, for there are gene complexes and gene complexes, and in some cases "undesirable tendencies" come to the fore in spite of the best possible environment, — granting that we know what the best possible environment is. The reciprocal of this we also see frequently, in individuals who escape the "Tobacco Roads" and somehow climb the balance arm of the scales which were weighted against them. As long as we do not know just what the limits are, can we countenance a "trial" in which the cards are stacked against the defendant?

If such an agnostic view of the situation has anything to offer in a program of Eugenic Reform — it is in emphasizing that such studies do not give us the whole answer, and that they give very little ground for a smug feeling that the genetic nature of social maladjustment has been "proved." We are brought around again in Stapleton's grassland experiments, where the only way to increase productivity proved to be to change both the heredity and the environment. Merely fertilizing a rundown pasture was not enough. Sowing new seed in the old environment did no better. The moral of this on the human plane is that merely fertilizing our slums with housing projects is not enough; nor is transplanting these populations to newly built resettlement projects much more helpful, for then we may lack both the cultural and genetic factors necessary to social integration. We are left therefore, with the rather appalling need to separate the human wheat from the tares at the same time we build our new human pasture lands through social readjustment. It is not likely that discoveries concerning the minutae of human genetics will be very much help in this process, because it will take a generation or two after we hold environment constant (granting that we ever succeed in this laudable aim) to obtain much information on which to base genetic conclusions. The principle recently enunciated by the American Eugenics Society of attempting to gain favorable distribution of births based on a rough-and-ready performance test in the mileau in question might go far toward a solution even while we are groping for that greater knowledge, which it is held in some quarters, must precede any attempt at an amelioration of the genetic constitution of mankind.

—R. C.

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The Wonder of Life

Ever since the Dresden Hygiene Exposition of 1911, which included a striking eugenics exhibit, the pre-eminence of the Germans in this field has been manifest. The Dresden exhibit has been maintained and enlarged and in the last few years a similar one has been prepared in Berlin and entitled "The Wonder of Life,"—"Das Wunder des Lebens." Reproductions of some of the material were brought to Pasadena some years ago for the national public health conference, and later made part of the Buffalo Museum. Dr. Bruno Gebhard, who was in charge of this exhibit, and who is again in the United States this winter to help the American Public Health Association prepare exhibit material, has used photographs of the remarkable Berlin exhibits as the basis for a huge book* whose scope is well indicated by the title.

Human biology is set forth in a fascinating, simple, yet accurate manner. Special attention is paid to heredity and eugenics as well as to health and hygiene. The style of the book and the illustrations and diagrams make it easy reading even for one whose knowledge of German is slight; indeed, it is an excellent help to the student who wants to learn the vocabulary. The book deserves to be widely known and used.

PAUL POPENOE

*GEBHARD, BRUNO. WUNDER DES LEBENS, with the collaboration of Herbert Michael, Gerhard A. Brecher, and Hatto Weiss. P. 429, 322 illus. RM 24. Stuttgart, Union Deutsche Verlagsgesellschaft, 1936.

ANOTHER EXPERIMENT ON LONG RANGE PATERNITY IN SHEEP

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THE use of artificial insemination to facilitate the improvement of livestock in this country has been limited, although the method has been extensively used in Russia. The exchange of semen by air express offers possibilities of increasing the influence of outstanding sires of proved worth by allowing their use simultaneously on flocks in widely separated sections of the country. Such exchanges would seem particularly adaptable to agricultural experiment stations, which maintain breeding animals for the primary purpose of producing superior stock.

The first successful attempt to send semen over a considerable distance by air was reported by Walton and Prawochenski.[4] They secured two impregnations in a total of five ewes inseminated with semen shipped from Cambridge, England to Warsaw, Poland, in which two days and three hours elapsed from the time of collection of the semen to its arrival at Warsaw. They further report the production of a lamb with semen kept four days before insemination. Winters[5] reported successful impregnation of two ewes with semen kept for six days.

Extensive use has been made of artificial insemination in some countries but comparatively little progress has yet been made in the successful storage and subsequent use of semen kept for long periods or transported over long distances.

During the fall of 1936 the Idaho Agricultural Experiment Station, Moscow, Idaho, expressed the desire to use an outstanding Lincoln ram at the U. S. Sheep Experiment Station, Dubois, Idaho. Since this ram was being used at the U. S. Sheep Experiment Station, a cooperative project was undertaken whereby ewes at Moscow, Idaho, were to be inseminated with semen from the ram at Dubois.

The semen was collected with a glass pipette from the vagina of a ewe out of estrus, placed in a small glass vial, covered with white mineral oil, corked and packed in cotton in a larger vial which was packed in cotton in a vacuum bottle partially filled with cracked ice.* The vacuum bottle was then packed in a cardboard carton and sent to Moscow by air and railway express.

Sixteen Lincoln ewes at Moscow, Idaho, were inseminated one or more times from six shipments of semen collected on October 9, 11, 14, 26, 27 and 31, 1936. The time elapsing from collection of the semen to insemination of the ewes varied from 22 to 50.5 hours, depending largely on the time spent in transit (a distance of about 700 miles). Estrus in the ewes was determined by teasing them twice daily with an aproned ram. A total of 28 inseminations were made of which 8 were near the onset of estrus, 10 additional during the first half, 4 during the second half, and 6 after the last observed evi-

*Techniques for artificial insemination have been reviewed by the Imperial Bureau of Animal Genetics[2] and in reports issued under the auspices of the Artificial Insemination Conference[1,6]. Some of the methods used in this project had been tried at the Missouri Agricultural Experiment Station.[3]

dence of estrus. The semen was introduced directly into the cervix with a glass pipette, using 0.2 c.c. of undiluted semen. Three ewes became pregnant and produced four healthy lambs. Two of these ewes had been inseminated during the second half of estrus, 44 hours after collection of the semen. The other ewe had been inseminated near the end of estrus, 27.5 hours after collection of the semen. A larger number of successes might have been obtained had it been possible to inseminate more of the ewes at the optimum stage of estrus, namely during the latter part.

Observations were made on semen of 16 ejaculates collected from the ram used, between October 7 and December 8, 1936. One or two ejaculates were obtained during the 30 minutes allowed for the collection of semen on each of the above days. The volume of the ejaculates varied from 0.3 to 1.8 c.c. with a mean of 0.9 c.c. Consistency of the semen was normal with the exception of two very thick ejaculates. Reaction to litmus paper was slightly alkaline to alkaline. Concentration of spermatozoa per c.c. ranged from 1,130 million to 2,490 million, with an average of 1,666 million. The degree of motility at collection ranged from a sluggish to a quiet progressive motion. The estimated percent of motile spermatozoa averaged about 50. The motility at the time of insemination was approximately equal to that at the time of collection. The maximum length of time that sperm were kept alive from this ram, when stored under oil at 4 to 6° Centigrade, was 6 days, and in some ejaculates only 2 days. Sperm from other station rams, collected at various times during this period and kept under similar conditions, have been kept alive for a maximum of 48 days, with a mean of 15 days. The number of abnormal spermatozoa per thousand ranged from 56 to 236, with a mean of 128, which compared with a mean of 137 for 44 rams.

When compared with similar observations made on semen from 44 rams, this ram was below average in concentration, motility, and duration of viability of the spermatozoa. However, fourteen ewes were bred to him at Dubois during November, 1936, and 13 of these produced lambs. Semen from the ram used, although the best of any from rams of this breed available, was below average in quality. Although the ram used was capable of settling a high proportion of his ewes under conditions of natural mating, the number of impregnations from artificial insemination might have been greater if a ram with semen above average in quality had been used.

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INHERITANCE OF PECTORAL BUFF SPOTTING

In the Cactus-Mouse, *Peromyscus Eremicus*

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BUFF colored spots on the breast occur frequently in some races of the cactus-mouse, *Peromyscus eremicus*. Huestis[3] noted that fifty-five per cent of the individuals of a stock of the subspecies *fraterculus* from La Jolla, California had a pectoral buff spot while twelve per cent had a buffy tinge on the ventral surface. In a study of microscopic hair characters, he crossed both spotted and nonspotted animals of this stock with mice of the subspecies *eremicus*, none of which exhibited either a spot or a tinge of buff in the pectoral region. One F_1 mouse out of 199 and 13 F_2 mice out of 147 had a pectoral buff spot while 4 F_2 mice had a buff tinge. Since nothing was known of the genetic composition of the wild *fraterculus* mice, he was unable to definitely analyze the inheritance of the character.

In the present study, crosses were made between three different subspecies of *Peromyscus eremicus*. The original stock of *fraterculus* was trapped by Dr. F. B. Sumner near La Jolla, California. The stock of the second subspecies, *papagensis*, was collected by Philip M. Blossom at Papago Tanks, Sonora, Mexico. The third subspecies, *eremicus*, was collected by Mr. Blossom at Tinajas Altas, Yuma County, Arizona, near the Mexican border. The field work of Mr. Blossom was financed in part by the Carnegie Institution of Washington.

The mice of these three subspecies differ greatly in the amount of pectoral buff spotting which they exhibit. Only a few mice of the subspecies *fraterculus* were available, but all of them had a buff spot or tinge on the breast. Some of the *papagensis* animals had a pectoral spot while others had no spot. No pectoral buff spotting of any kind was found in mice of the subspecies *eremicus* and all of the ventral hairs have long white tips. In *papagensis* and *fraterculus*, however, a varying number of hairs on the breast may have yellow terminal bands like the hairs on the lateral line. A group of these yellow-tipped hairs show up plainly as a yellow or buff pectoral spot on an otherwise white or light gray surface. If the yellow bands on the affected hairs are subterminal or very narrow, a less conspicuous spot or tinge results. There seems to be no good reason for considering buff spot and buff tinge separate characters.

Several mice of the subspecies *fraterculus* with small but distinct pectoral buff spots were mated together. Twenty-two young were produced and every one had a distinct spot or a tinge of buff on the breast. Some of these young mice had spots smaller than those exhibited by their parents while others had spots which covered the pectoral region and were continuous with the normal buff color on the flanks.

Several mice of the subspecies *papagensis* which had small pectoral buff spots were mated together. Sixty-six young resulted from these crosses and all but one had at least several yellow-tipped hairs in the pectoral region. The

*The research work reported in this paper was carried on and completed at the University of Michigan while the author was on the staff of the Laboratory of Vertebrate Genetics.

one exception did not exhibit either a tinge nor a trace of a buff spot.

Several of the spotted mice from the *papagensis* stock were crossed with nonspotted mice of the subspecies, *eremicus*. Fifty F_1 young were produced and only one of them had a pectoral spot. Several of these non-spotted F_1 animals were mated together and produced a total of 96 F_2 young, 73 of which were nonspotted, while 23 had a pectoral spot or tinge of buff. This is a deviation of only 1.00 ± 0.35 from the 3:1 ratio that one would expect if pectoral buff spot were caused by the homozygous action of a single recessive gene. Two apparent objections to such a simple interpretation of the inheritance of this character have been mentioned above. In the matings of spotted *papagensis* mice, one of the resulting 66 young did not have a pectoral buff spot. The frequent failure of a white recessive belly-spot in the house-mouse (*Mus musculus*) to appear when an individual is genetically homozygous for it has been reported (Clark[1]), and such cases of so called normal overlaps are common. The production of this one nonspotted *papagensis* animal therefore does not invalidate any conclusions we may draw as to the simple inheritance of this character.

The appearance of one spotted F_1 young from matings of spotted *papagensis* with self colored *eremicus* mice is harder to explain. The *eremicus* ♀ that produced this spotted mouse apparently was not heterozygous for pectoral buff spot for she gave birth to more than 20 other F_1 young none of which was spotted. Huestis[3] likewise obtained one spotted F_1 mouse among 199 from a similar cross and states that "the presence of this character in the F_1 generation suggests that it is not a simple recessive, although the possibility of a heterozygous *eremicus* female cannot be excluded. . . ." Several more or less logical explanations may be suggested.

In the first place, a mutation may have occurred in one chromosome of at least one of the germ cells of the *eremicus* female. Cases where genes have mutated from a dominant to a recessive condition are well known both in plants and animals. Then, too, there are very few characters that are really as simple as we imagine them to be. Many genes have multiple effects and even although the occurrence of a simple character like pectoral buff spot may depend upon a single recessive gene, it is quite possible, and even probable, that the degree of its expression is influenced by many other genes and also by environmental factors. Thus occasionally in an animal which has a certain genetic complex, a single dose of this gene might be sufficient to cause a pectoral buff spot, or, in other words, the gene might behave as a dominant in a certain genetic complex. Such an explanation would be reasonable according to Fisher's theory of the evolution of dominance.[2]

Conclusions

Pectoral buff spot or tinge in the cactus-mouse, *Peromyscus eremicus*, is caused by the presence of a variable number of hairs with a yellow terminal or subterminal band in the pectoral region. Pectoral buff spotting is inherited essentially as a simple Mendelian recessive character, and unexpected deviations in its expression are probably due to other modifying genes or to environmental factors.

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